State of California
The Resources Agency
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SP-T8 Project Effects on Non-Native Wildlife Draft Final Report

Oroville Facilities Relicensing FERC Project No. 2100

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GRAY DAVIS
Governor
State of California

MARY D. NICHOLS
Secretary for Resources
The Resources Agency

MICHAEL J. SPEAR
Interim Director
Department of Water Resources

State of California
The Resources Agency
Department of Water Resources

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Draft Final Report

Oroville Facilities Relicensing
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This report was prepared under the direction of

Dale Hoffman-Floerke ....Resource Area Manager, DWR
Terry Mills...Resource Area Manager, DWR

by

Dave Bogener ....Staff Environmental Scientist, DWR

Assisted by

Amy Brinkhaus ....Wildlife Biologist, DFG

REPORT SUMMARY

This report presents the results of the three tasks identified in Study Plan SP-T8.

- Task 1-Literature review of species biology, habitat requirements, life history, and control/eradication methods relative to the 14 non-native species identified in SP-T8.
- Task 2-Qualitative assessment of each species distribution and population levels within the project area.
- Task 3-Identification of potential management practices which have the potential to limit the occurrence of these species within the project area.

Qualitative assessment of non-native species distribution and population levels indicates that feral pig, bobwhite quail, and red fox are absent or extremely uncommon within the project area. The qualitative methods employed within this study were unsuitable for determination of species distribution and population levels of black rat, house mouse, and Norway rat. However, extensive areas of potentially suitable habitat are present within the project area for all three rodents. Moderate densities of rock dove and house sparrow were strongly associated with human structures. European starling exhibited wide-spread distribution within the project area with the highest densities observed along the urban/wildland interface. This assessment identified high densities of bullfrogs within suitable habitat in the Oroville Wildlife Area and high densities of wild turkeys within portions of the lands managed by DPR.

Identification of potential management practices for population control of non-native species were primarily developed through review of published literature. These management practices are provided as a reference to land management agencies rather than as recommendations. It appears likely that each land management agency may consider differing control mechanisms, as appropriate, on a site and species specific basis to meet management goals.

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1.0 INTRODUCTION

The California Wildlife Habitat Relationships Program identifies 14 non-native vertebrate wildlife species as having potential to occur within the project area, including six birds, seven mammals, and one amphibian (Table 1.0-1).

Table 1.0-1. List of Non-Native Vertebrate Wildlife Species Potentially Found within the Project Area

Common Name	Scientific Name	Status
Bullfrog	*Rana catesbeiana*	DFG Harvest
House sparrow	*Passer domesticus*	
Bobwhite quail	*Colinus virginianus*	DFG Harvest
Ring-necked pheasant	*Phasianus colchicus*	DFG Harvest
Wild turkey	*Meleagris gallopavo*	DFG Harvest
Rock dove	*Columba livia*	
European starling	*Sturnus vulgaris*	
Virginia opossum	*Didelphis virginiana*	DFG Harvest
Black rat	*Rattus rattus*	
Norway rat	*Rattus norvegicus*	
House mouse	*Mus musculus*	
Muskrat	*Ondatra zibethicus*	DFG Harvest
Red fox	*Vulpes vulpes*	
Feral pig	*Sus scrofa*	DFG Harvest

Several of these species were introduced by the California Department of Fish and Game (DFG) as harvest species, or are currently managed as harvest species (Table 1.0-1). All of these species compete with, displace, or prey upon native wildlife to a certain extent.

The three principal land management agencies within the project area are the California Department of Fish and Game, the California Department of Parks and Recreation (DPR), and the California Department of Water Resources (DWR). Each of these agencies has differing management goals and policies related to non-native species which are largely dictated by their varied missions.

The DWR is primarily concerned with those non-native species which damage project facilities, disrupt operations, or occur in densities which represent a public health hazard. Periodic inspections of project facilities including levees are conducted. Past control activities aimed at these species have been limited and generally restricted to rodenticide use related to project structures. Rodent control activities occur annually at certain locations including Thermalito Afterbay and Forebay levees. These control activities are principally aimed at control of California ground squirrels. However these control methods (vegetation control and bait stations) also serve to control non-native rodents.

Part of the DFG mission is to manage wildlife and habitats for use and enjoyment by the public. This public use and enjoyment is not restricted to native species. Bullfrog, Virginia opossum, ring-necked pheasant, wild turkey, muskrat, bobwhite quail, feral pig, and red fox are DFG harvest species. DFG actively manages habitats within the Oroville Wildlife Area to produce hunt-able populations of ring-necked pheasants and wild turkeys. Another part of the CDFG mission is to maintain native fish, wildlife, plant species and natural communities for their intrinsic and ecological value. So, an additional responsibility of the DFG is to insure that non-native species populations are controlled at levels which do not adversely impact native species or habitats

A part of the DPR's mission is to preserve the State's extraordinary biological diversity. To maintain biological diversity management policy is directed toward preservation of native species and plant communities and exclusion or eradication of non-native species.

The primary purpose of Study Plan T-8 is to provide information to land management agencies on potential management practices for population control of non-native species as appropriate to meet each agencies land and wildlife management goals.

1.1 DESCRIPTION OF FACILITIES

The Oroville Facilities were developed as part of the State Water Project (SWP), a water storage and delivery system of reservoirs, aqueducts, power plants, and pumping plants. The main purpose of the SWP is to store and distribute water to supplement the needs of urban and agricultural water users in northern California, the San Francisco Bay area, the San Joaquin Valley, and southern California. The Oroville Facilities are also operated for flood management, power generation, to improve water quality in the Delta, provide recreation, and enhance fish and wildlife.

FERC Project No. 2100 encompasses 41,100 acres and includes Oroville Dam and Reservoir, three power plants (Hyatt Pumping-Generating Plant, Thermalito Diversion Dam Power Plant, and Thermalito Pumping-Generating Plant), Thermalito Diversion Dam, the Feather River Fish Hatchery and Fish Barrier Dam, Thermalito Power Canal, Oroville Wildlife Area (OWA), Thermalito Forebay and Forebay Dam, Thermalito Afterbay and Afterbay Dam, and transmission lines, as well as a number of recreational facilities. An overview of these facilities is provided on Figure 1.2-1. The Oroville Dam, along with two small saddle dams, impounds Lake Oroville, a 3.5-million-acre-feet (maf) capacity storage reservoir with a surface area of 15,810 acres at its normal maximum operating level.

The hydroelectric facilities have a combined licensed generating capacity of approximately 762 megawatts (MW). The Hyatt Pumping-Generating Plant is the largest of the three power plants with a capacity of 645 MW. Water from the six-unit underground power plant (three conventional generating and three pumping-generating units) is discharged through two tunnels into the Feather River just downstream of Oroville Dam. The plant has a generating and pumping flow capacity of 16,950 cfs and 5,610 cfs, respectively. Other generation facilities include the 3-MW Thermalito Diversion Dam Power Plant and the 114-MW Thermalito Pumping-Generating Plant.

Thermalito Diversion Dam, four miles downstream of the Oroville Dam creates a tail water pool for the Hyatt Pumping-Generating Plant and is used to divert water to the Thermalito Power Canal. The Thermalito Diversion Dam Power Plant is a 3-MW power plant located on the left abutment of the Diversion Dam. The power plant releases a maximum of 615 cubic feet per second (cfs) of water into the river.

The Power Canal is a 10,000-foot-long channel designed to convey generating flows of 16,900 cfs to the Thermalito Forebay and pump-back flows to the Hyatt Pumping-Generating Plant. The Thermalito Forebay is an off-stream regulating reservoir for the 114-MW Thermalito Pumping-Generating Plant. The Thermalito Pumping-Generating Plant is designed to operate in tandem with the Hyatt Pumping-Generating Plant and has generating and pump-back flow capacities of 17,400 cfs and 9,120 cfs, respectively. When in generating mode, the Thermalito Pumping-Generating Plant discharges into the Thermalito Afterbay, which is contained by a 42,000-foot-long earth-fill dam. The Afterbay is used to release water into the Feather River downstream of the Oroville Facilities, helps regulate the power system, provides storage for pump-back operations, and provides recreational opportunities. Several local irrigation districts receive water from the Afterbay.

The Feather River Fish Barrier Dam is downstream of the Thermalito Diversion Dam and immediately upstream of the Feather River Fish Hatchery. The flow over the dam maintains fish habitat in the low-flow channel of the Feather River between the dam and the Afterbay outlet, and provides attraction flow for the hatchery. The hatchery was intended to compensate for spawning grounds lost to returning salmon and steelhead trout from the construction of Oroville Dam. The hatchery can accommodate 15,000 to 20,000 adult fish annually.

The Oroville Facilities support a wide variety of recreational opportunities. They include: boating (several types), fishing (several types), fully developed and primitive camping (including boat-in and floating sites), picnicking, swimming, horseback riding, hiking, off-road bicycle riding, wildlife watching, hunting, and visitor information sites with cultural and informational displays about the developed facilities and the natural environment. There are major recreation facilities at Loafer Creek, Bidwell Canyon, the Spillway, North and South Thermalito Forebay, and Lime Saddle. Lake Oroville has two full-service marinas, five car-top boat launch ramps, ten floating campsites, and seven dispersed floating toilets. There are also recreation facilities at the Visitor Center and the OWA.

The OWA comprises approximately 11,000-acres west of Oroville that is managed for wildlife habitat and recreational activities. It includes the Thermalito Afterbay and surrounding lands (approximately 6,000 acres) along with 5,000 acres adjoining the Feather River. The 5,000 acre area straddles 12 miles of the Feather River, which includes willow and cottonwood lined ponds, islands, and channels. Recreation areas include dispersed recreation (hunting, fishing, and bird watching), plus recreation at developed sites, including Monument Hill day use area, model airplane grounds, three boat launches on the Afterbay and two on the river, and two primitive camping areas. California Department of Fish and Game's (DFG) habitat enhancement program includes a wood duck nest-box program and dry land farming for nesting cover and improved wildlife forage. Limited gravel extraction also occurs in a number of locations.

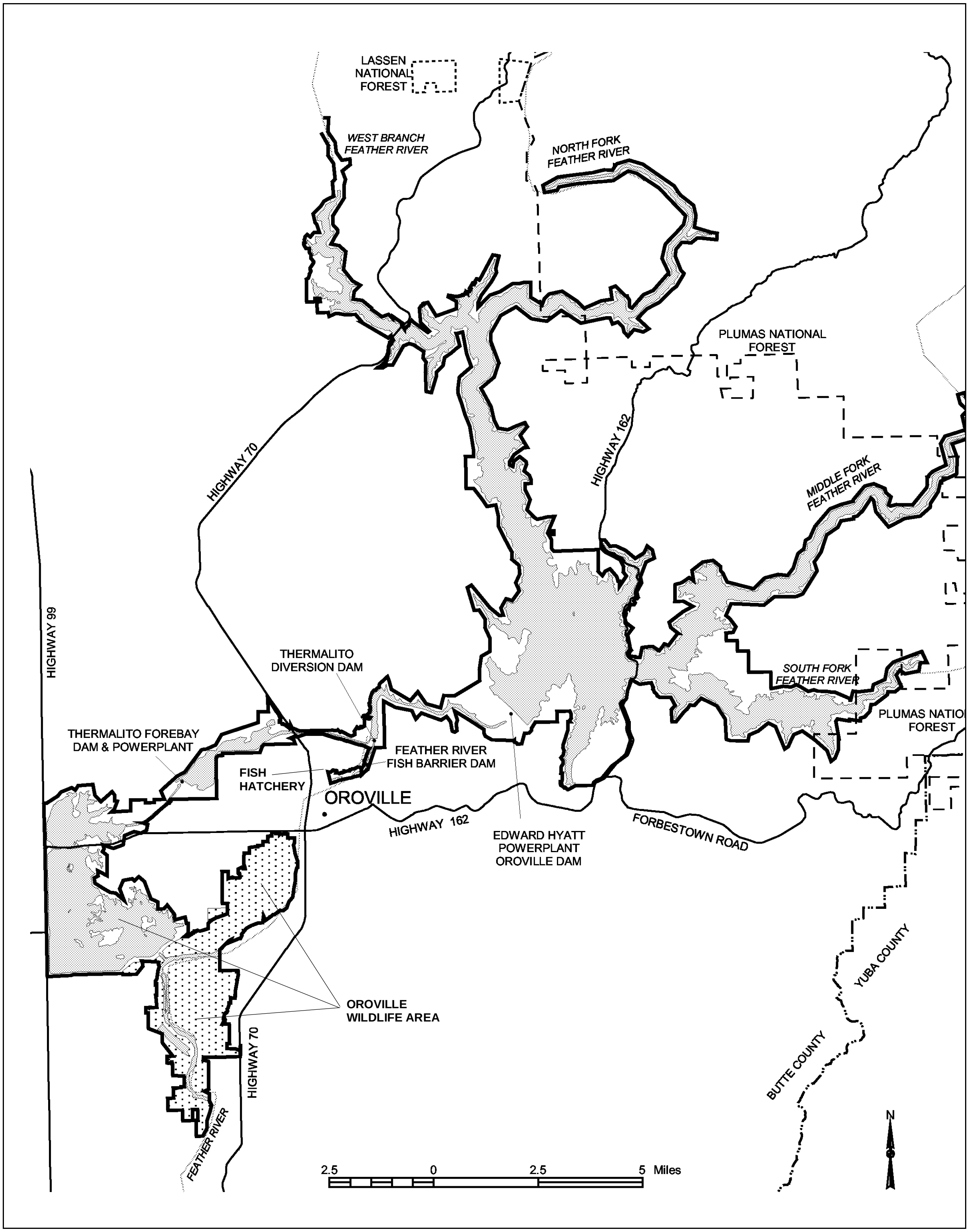

Figure 1.2-1. Oroville Facilities FERC Project Boundary

1.3 CURRENT OPERATIONAL CONSTRAINTS

Operation of the Oroville Facilities varies seasonally, weekly and hourly, depending on hydrology and the objectives DWR is trying to meet. Typically, releases to the Feather River are managed to conserve water while meeting a variety of water delivery requirements, including flow, temperature, fisheries, recreation, diversion and water quality. Lake Oroville stores winter and spring runoff for release to the Feather River as necessary for project purposes. Meeting the water supply objectives of the SWP has always been the primary consideration for determining Oroville Facilities operation (within the regulatory constraints specified for flood control, in-stream fisheries, and downstream uses). Power production is scheduled within the boundaries specified by the water operations criteria noted above. Annual operations planning is conducted for multi-year carry over. The current methodology is to retain half of the Lake Oroville storage above a specific level for subsequent years. Currently, that level has been established at 1,000,000 acre-feet (af); however, this does not limit draw down of the reservoir below that level. If hydrology is drier than expected or requirements greater than expected, additional water would be released from Lake Oroville. The operations plan is updated regularly to reflect changes in hydrology and downstream operations. Typically, Lake Oroville is filled to its maximum annual level of up to 900 feet above mean sea level (msl) in June and then can be lowered as necessary to meet downstream requirements, to its minimum level in December or January. During drier years, the lake may be drawn down more and may not fill to the desired levels the following spring. Project operations are directly constrained by downstream operational constraints and flood management criteria as described below.

1.3.1 Downstream Operation

An August 1983 agreement between DWR and DFG entitled, “Agreement Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish & Wildlife,” sets criteria and objectives for flow and temperatures in the low flow channel and the reach of the Feather River between Thermalito Afterbay and Verona. This agreement: (1) establishes minimum flows between Thermalito Afterbay Outlet and Verona which vary by water year type; (2) requires flow changes under 2,500 cfs to be reduced by no more than 200 cfs during any 24-hour period, except for flood management, failures, etc.; (3) requires flow stability during the peak of the fall-run Chinook spawning season; and (4) sets an objective of suitable temperature conditions during the fall months for salmon and during the later spring/summer for shad and striped bass.

1.3.1.1 Instream Flow Requirements

The Oroville Facilities are operated to meet minimum flows in the Lower Feather River as established by the 1983 agreement (see above). The agreement specifies that Oroville Facilities release a minimum of 600 cfs into the Feather River from the

Thermalito Diversion Dam for fisheries purposes. This is the total volume of flows from the diversion dam outlet, diversion dam power plant, and the Feather River Fish Hatchery pipeline.

Generally, the instream flow requirements below Thermalito Afterbay are 1,700 cfs from October through March, and 1,000 cfs from April through September. However, if runoff for the previous April through July period is less than 1,942,000 af (i.e., the 1911-1960 mean unimpaired runoff near Oroville), the minimum flow can be reduced to 1,200 cfs from October to February, and 1,000 cfs for March. A maximum flow of 2,500 cfs is maintained from October 15 through November 30 to prevent spawning in overbank areas that might become de-watered.

1.3.1.2 Temperature Requirements

The Diversion Pool provides the water supply for the Feather River Fish Hatchery. The hatchery objectives are 52°F for September, 51°F for October and November, 55°F for December through March, 51°F for April through May 15, 55°F for last half of May, 56°F for June 1-15, 60°F for June 16 through August 15, and 58°F for August 16-31. A temperature range of plus or minus 4°F is allowed for objectives, April through November.

There are several temperature objectives for the Feather River downstream of the Afterbay Outlet. During the fall months, after September 15, the temperatures must be suitable for fall-run Chinook. From May through August, they must be suitable for shad, striped bass, and other warmwater fish.

The National Marine Fisheries Service has also established an explicit criterion for steelhead trout and spring-run Chinook salmon. Memorialized in a biological opinion on the effects of the Central Valley Project and SWP on Central Valley spring-run Chinook and steelhead as a reasonable and prudent measure; DWR is required to control water temperature at Feather River mile 61.6 (Robinson's Riffle in the low-flow channel) from June 1 through September 30. This measure requires water temperatures less than or equal to 65°F on a daily average. The requirement is not intended to preclude pump-back operations at the Oroville Facilities needed to assist the State of California with supplying energy during periods when the California ISO anticipates a Stage 2 or higher alert.

The hatchery and river water temperature objectives sometimes conflict with temperatures desired by agricultural diverters. Under existing agreements, DWR provides water for the Feather River Service Area (FRSA) contractors. The contractors claim a need for warmer water during spring and summer for rice germination and growth (i.e., 65°F from approximately April through mid May, and 59°F during the remainder of the growing season). There is no obligation for DWR to meet the rice water temperature goals. However, to the extent practical, DWR does use its operational flexibility to accommodate the FRSA contractor's temperature goals.

1.3.1.3 Water Diversions

Monthly irrigation diversions of up to 190,000 (July 2002) af are made from the Thermalito Complex during the May through August irrigation season. Total annual entitlement of the Butte and Sutter County agricultural users is approximately 1 maf. After meeting these local demands, flows into the lower Feather River continue into the Sacramento River and into the Sacramento-San Joaquin Delta. In the northwestern portion of the Delta, water is pumped into the North Bay Aqueduct. In the south Delta, water is diverted into Clifton Court Forebay where the water is stored until it is pumped into the California Aqueduct.

1.3.1.4 Water Quality

Flows through the Delta are maintained to meet Bay-Delta water quality standards arising from DWR's water rights permits. These standards are designed to meet several water quality objectives such as salinity, Delta outflow, river flows, and export limits. The purpose of these objectives is to attain the highest water quality, which is reasonable, considering all demands being made on the Bay-Delta waters. In particular, they protect a wide range of fish and wildlife including Chinook salmon, Delta smelt, striped bass, and the habitat of estuarine-dependent species.

1.3.2 Flood Management

The Oroville Facilities are an integral component of the flood management system for the Sacramento Valley. During the wintertime, the Oroville Facilities are operated under flood control requirements specified by the U.S. Army Corps of Engineers (USACE). Under these requirements, Lake Oroville is operated to maintain up to 750,000 af of storage space to allow for the capture of significant inflows. Flood control releases are based on the release schedule in the flood control diagram or the emergency spillway release diagram prepared by the USACE, whichever requires the greater release. Decisions regarding such releases are made in consultation with the USACE.

The flood control requirements are designed for multiple use of reservoir space. During times when flood management space is not required to accomplish flood management objectives, the reservoir space can be used for storing water. From October through March, the maximum allowable storage limit (point at which specific flood release would have to be made) varies from about 2.8 to 3.2 maf to ensure adequate space in Lake Oroville to handle flood flows. The actual encroachment demarcation is based on a wetness index, computed from accumulated basin precipitation. This allows higher levels in the reservoir when the prevailing hydrology is dry while maintaining adequate flood protection. When the wetness index is high in the basin (i.e., wetness in the watershed above Lake Oroville), the flood management space required is at its greatest amount to provide the necessary flood protection. From April through June, the maximum allowable storage limit is increased as the flooding potential decreases, which allows capture of the higher spring flows for use later in the year. During September, the maximum allowable storage decreases again to prepare for the next flood season. During flood events, actual storage may encroach into the flood reservation zone to prevent or minimize downstream flooding along the Feather River.

2.0 NEED FOR STUDY

Relicensing participants have identified project effects including land management, project facilities, and operation on non-native wildlife as a relicensing issue. Non-native wildlife species can adversely impact native wildlife (including State and federal special status species) through competition, predation, and disease. Further, several of the non-native species have evolved in close association with humans and carry and transmit diseases to humans. NEPA requires an assessment of public health impacts. Many of the currently developed recreation facilities contain features or activities that are attractive to these non-native species.

3.0 STUDY OBJECTIVE(S)

Identify potential changes in project operations, land use, features, and management practices which could serve to reduce the potential impact of these non-native wildlife species on native species and their habitats.

4.0 METHODOLOGY

Task1

After review of existing literature, a brief description of each species' biology, life history, and population control methods were compiled. These descriptions included information on the non-native species interactions with native species, including humans.

Information on habitat requirements was developed through query of the California Wildlife Habitat Relationships database. CWHR queries identified optimal habitats/seral stages within the project area for each species. Optimal habitats/seral stages were defined as any seral stage of any habitat where an optimal value (1.0) was predicted for food, cover, and reproduction. Definition of optimal habitat can be used to predict where high densities of non-native species may occur and may also offer a potential population control mechanism through direct habitat modification. Further, CWR was queried to identify habitat elements that are important to each species. CWHR ranks elements into the four classes defined below:

- Essential-the element must be present within the species home range or the species will be absent
- Secondarily Essential- the element must be present within the species home range for the species to be present unless it is compensated by the presence of another habitat element.
- Preferable-the element enhances the value of the habitat but is not essential for species presence
- Not Rated-the element does not enhance the habitat for the species

Elimination of essential and secondarily essential habitat elements is a potential control mechanism for non-native species. However, these same habitat elements are frequently essential or secondarily essential to native species as well.

Task 2

During the course of terrestrial resource relicensing studies all observations/detections of the 14 non-native species were recorded relative to habitat type and project features. No additional survey of non-native species was conducted. This methodology provided fairly good information on the distribution and occurrence of avian species, bullfrogs, and feral pigs. This methodology provided very little information on the occurrence and distribution of small mammals or mesocarnivores. CWHR predictions of optimal habitat/essential elements were used to supplement visual observations and are the primary source of occurrence/distribution data for small mammals and mesocarnivores.

Task 3

Identification of potential management practices for population control of non-native species were primarily developed through review of published literature. These management practices are provided as a reference to land management agencies rather than as recommendations. It appears likely that each land management agency may select differing control mechanisms, as appropriate, on a site specific basis.

5.0 STUDY RESULTS

BULLFROG

The bullfrog, native to the eastern United States, was introduced to California in the early 1900s and is now designated as a DFG harvest species (Zeiner et al. 1990a). Bullfrogs are common and wide spread throughout the low elevation marsh, riparian, and other wetland habitats. California Wildlife Habitat Relationship database (CWHR) analyses indicate that no ideal habitat type/seral stage for this species exists within the project area, but various stages of fresh emergent wetland, lacustrine, and valley riparian inclusions do provide high quality habitat for the bullfrog. Within the project area, there are 8 acres, 261 acres, and 96 acres of each habitat type, respectively. The highest bullfrog densities observed within the project area occur within the permanent dredger ponds of the Oroville Wildlife Area. Low densities occur along the margin of Thermalito Forebay, Thermalito Afterbay, and Diversion Pool. Bullfrogs rarely occur within Lake Oroville.

CWHR analyses indicate that algae, invertebrates, and a permanent source of slow-moving water are essential habitat elements for the bullfrog. Ponds, rivers, streams, and emergent aquatic vegetation are secondarily essential habitat elements, while vernal pools are a preferred element. Bullfrog tadpoles feed mainly on algae and diatoms, as well as some plant material. Adult bullfrogs are opportunistic feeders, taking both aquatic and terrestrial prey, including invertebrates, fish, native frogs and tadpoles, snakes, birds, salamanders, toads, turtles, and mice (Zeiner et al. 1990a). Juvenile and tadpole bullfrogs are preyed upon by aquatic insects, fish, garter snakes, wading birds, a variety of mammals, and raptors. Adult bullfrogs are taken by many larger vertebrate predators (Bury and Whelan 1984; Zeiner et al. 1990a).

The bullfrog is the largest frog in California. This species competes with and preys upon native amphibians with which it coexists. Bullfrog populations have been linked with the decline of native species associated with emergent wetland habitats (Zeiner et al. 1990a; Hecnar and M'Closkey 1997; Kiesecker et al. 2001).

Control methods for the bullfrog are not readily available. Researchers have studied the ecology and biology of this species to look for possible control methods. Habitat and land practice modification may be options, as researchers have found that cattle grazing and its associated stock ponds seems to favor bullfrog populations (Moyle 1973), while the effect of bullfrog presence on native ranids was negligible in ponds where food resources were scattered rather than clumped (Kiesecker et al. 2001). Conservation of ephemeral wetlands is recommended to benefit native amphibians and to potentially reduce the threat of bullfrogs, as they are generally associated with permanent wetlands (Adams 1999). Current levels of harvest do not appear to limit or control bullfrog populations within the project area.

HOUSE SPARROW

House sparrows were first introduced from Europe into the eastern United States around 1850 and rapidly spread across the country, arriving in California at San Francisco in the early 1870s (Ziener et al. 1990). This species is most successful in close association with man (Gavett and Wakeley 1986). The ideal habitat type for this species is urban, of which 659 acres exist within the study area. Croplands (primarily grain crops) are a preferred habitat (Ziener et al. 1990b). Buildings are the only essential habitat element. Consequently, house sparrows occur throughout the project area near human habitation or livestock, with highest densities frequently near outdoor restaurants, stables, and other human developments. The highest densities observed within the project area were along the Kelly Ridge urban interface. However, house sparrows were regularly observed in and around campgrounds, marinas, and bridges. This species was generally absent from areas lacking structures.

Seeds and grains are secondarily essential habitat elements. The house sparrows' diet consists primarily of commercial cereal grains in rural areas and commercial bird seed in urban areas. The diet is supplemented with insects, grass and weed seeds, and various plant fragments (Gavett and Wakeley 1986). Often, this species will scavenge human food scraps (Ziener et al. 1990b).

House sparrows are aggressive nesters and frequently displace native avian species by evicting nesting adults or destroying eggs and nestlings. This species primarily impacts secondary cavity nesting species including swallows, western bluebirds, house wrens, and house finches (Ziener et al. 1990b).

Researchers have studied the effectiveness of monofilament lines as house sparrow repellants at nesting and feeding sites. These widely-spaced lines, when stretched over feeding sites, prove to be highly effective in repelling house sparrows from the treated area by creating a visual barrier. The method is more effective during the winter than during reproductive activity, which may be attributable to less wariness of predators during reproductive activity (Aguero 1991). When used as a deterrent at nest boxes, monofilament lines were not found to be effective in repelling house sparrows, but did appear to delay initial acceptance of the nest boxes. This response is also believed to be attributable to low wariness of predators, as nest sites are usually chosen in areas of low predator risk. The delay in acceptance, however, may allow other cavity nesters to initiate and defend their nests against this species (Pochop et al. 1993). Existing structures could be modified to limit their suitability as house sparrow nest sites by physically blocking cavities, niches, or open eves. However, these physical modifications will also limit native species use of these structures as well.

Human food scraps are an attractant for this species. The availability of food scraps can be controlled with proper garbage storage and public education about the effects of feeding wildlife.

BOBWHITE QUAIL

Bobwhite quail (Northern bobwhite) were introduced to California for hunting, and are commonly used in field training activities and as part of licensed game bird club operations. This species has not established itself in the wild in California, but is designated as a DFG harvest species to allow the take of remnant birds from the above-mentioned activities (DFG pers. communication 2003). The bobwhite quail is hunted within the project boundary. Bobwhite quail prefer interspersed areas of open woodlands, brush, grass, and croplands. No bobwhite quail were observed during the course of the relicensing studies. However, small populations have been observed sporadically in the past near brood pond #4 at the south end of Wilbur Road. This location receives significant seasonal use for dog trial activities.

The bobwhite quail's diet consists mainly of seeds, small hard mast, leaves, fruits, insects, and snails. This species does not require surface water, as it is able to meet its water needs with dew drops or from its diet (North Carolina State University).

The effect of bobwhite quail on native wildlife species has not been determined. However, this species and the native California quail have similar food and habitat requirements, which could lead to resource competition. A potential control mechanism could involve elimination of the use of bobwhite quail in dog trials or training activities within the project area. However, the lack of bobwhite quail observations during the course of relicensing studies indicates that current levels of introduction are inadequate to sustain a population. Sport hunting is currently the primary population control mechanism within the project area.

RING-NECKED PHEASANT

The ring-necked pheasant was introduced from Eurasia for sport hunting, and captive raised pheasants continue to be released throughout California by hunters and hunt clubs. This species is designated as a DFG harvest species. The ideal habitat type for the ring-necked pheasant is tall annual grassland with dense cover, of which 796 acres exist in the project area. Ring-necked pheasants were commonly observed in upland habitats around the Thermalito Afterbay and occasionally observed near the Thermalito Forebay and within grassland habitats in other portions of the Oroville Wildlife Area. This species is uncommon or absent from other areas within the project boundary.

CWHR analyses indicate that essential habitat elements for the ring-necked pheasant are grains and an herbaceous layer. Secondarily essential habitat elements for this species include seeds, insects, and a shrub or grassland edge with agriculture. Graminoids, invertebrates, emergent aquatic vegetation, and gravelly soil are preferred.

The ring-necked pheasants' diet consists of waste grain, seeds and other plant parts, insects, and arthropods. Highest densities of this species tend to occur where open water is available (Zeiner et al. 1990b).

The effect of ring-neck pheasant populations on native wildlife species has not been determined. However, this ground nesting, parasitic egg-laying species may negatively impact other native species (Zeiner et al. 1990b).

Sport hunting is currently the primary population control mechanism within the project area.

WILD TURKEY

Wild turkeys were introduced to California in 1877. The range of wild turkey populations continues to expand in hilly oak woodland habitat (Zeiner et al. 1990b). Wild turkeys are designated as a DFG harvest species and are hunted in several locations within the project boundary, including the Oroville Wildlife Area. Ideal habitat types for this species are tall annual grasslands with dense cover (of which 796 acres exist in the project area), as well as areas of sapling to large-size trees with sparse to moderate cover in blue oak woodland (of which 4,616 acres exist within the project area), blue oak-foothill pine (of which 6,616 acres exist within the project area), montane hardwood (of which 5,209 acres exist within the project area), montane hardwood-conifer (of which 9,754 acres exist within the project area), and montane riparian (of which 46 acres exist within the project area). Another ideal habitat type for this species is areas of sapling-size trees with sparse to open cover in ponderosa pine, but this stage of this habitat type does not exist within the project area. Wild turkeys were regularly observed throughout woodland and forest habitats within the project area. The highest densities were observed within the Loafer Creek area. This relatively large area of excellent habitat is currently not open to sport hunting. Wild turkeys in this area have become quite tame, frequently foraging or roosting in areas of high recreational use.

The wild turkey does not have any essential habitat elements, but seeds, acorns, and an herbaceous layer are secondarily essential habitat elements. A steep slope is preferred for escape from predators. This species' diet consists of seeds, leaves, fruits, buds, acorns, nuts, and arthropods. Wild turkeys are preyed upon by bobcats, foxes, and domestic dogs. Their eggs are preyed upon by ravens, crows, skunks, and snakes (Zeiner et al. 1990b).

The effect of wild turkey populations on native wildlife species, rare plants and natural communities have recently been evaluated (DFG 2003). This evaluation failed to identify any significant impacts to native species related to wild turkey introductions. However, potential incidental predation of some special status invertebrates, reptiles and amphibians may occur. Likewise, turkeys are known to forage on several genera of special status plant species including Carex sp., Erigeron sp., Eriogonum sp., Ranunculus sp., and Silene sp.. Acorns are an important seasonal food source for a variety of terrestrial wildlife species including non-native turkeys. Competition for acorns between wild turkeys and native species during years of low mast production could adversely impact some native species. However, these impacts have not been quantified. Sport hunting is currently the primary population control mechanism within those portions of the project area where hunting is allowed.

ROCK DOVE

Rock doves (domestic pigeons) were introduced from Europe into the United States prior to 1800, most likely as a food source. The ideal habitat type for this species is urban, of which 659 acres exist within the study area. Preferred habitats include perennial and annual grasslands, as well as croplands and pasture (Zeiner et al. 1990b). Buildings, an herbaceous layer, and water are essential habitat elements for rock doves. Rock doves were regularly observed along the urban interface and associated with structures including bridges, dams, and other water control structures.

Seeds, grains, transmission lines, and a grass/agriculture edge are secondarily essential habitat elements.

The rock doves' diet consists of grains, seeds, grasses, forbs, bread, and other human food scraps (Ziener et al. 1990b). This species may compete with native species for food resources including waste grains, seeds, and human food scraps.

Rock doves nest within sheltered locations in a variety of human-related structures, including bridges and buildings (Harrison 1978). Nesting preferences may result in direct competition with other native species such as the barn swallow. Rock doves are preyed upon by several native species including the peregrine falcon and several species of carnivorous furbearers.

Rendering perch sites inaccessible or unsuitable can effectively reduce habitat suitability for this species (Van Vuren 1998). Preliminary research on the effectiveness of closely-spaced monofilament lines as a rock dove repellant shows that this species can be deterred from landing on ledges. The lines provide a physical barrier for this species, which reduces or eliminates the number of rock doves landing on treated ledges (Andelt and Burnham 1993). However, physical modification of structures to limit their suitability for rock dove nesting or roosting can adversely impact several groups of native species including bats, secondary cavity nesters, swallows, barn owls, and peregrine falcon. Trapping and removal have successfully reduced populations in localized settings.

Rock doves can transmit diseases and parasites to humans and domestic animals. Removal of individuals to reduce populations has resulted in the replacement or over-replacement of those removed. The food base appears to be the limiting factor (Haag-Wackemagel 1995). Human food scraps are an attractant for this species. The availability of food scraps can be controlled with proper garbage storage and public education about the effects of feeding wildlife. Sport hunting is currently the primary population control mechanism within those portions of the project area where hunting is allowed.

EUROPEAN STARLING

European starlings were introduced into the United States from Europe and are now widespread and common to abundant throughout most of California (Zeiner et al. 1990b). The ideal habitat types for this species are sparse to open areas of pole to large-size trees in blue oak woodland (1,732 acres within the project area) and blue oak-foothill pine (570 acres within the project area). The urban habitat is also ideal, of which 659 acres exist within the project area. Preferred habitats include cropland, pasture, and orchard/vineyard . This species is often concentrated near human habitations and dumps (Zeiner et al. 1990b), and is currently an abundant species within the project area and nearby agricultural habitats.

Invertebrates and terrestrial insects are essential habitat elements.   The European starling also feeds on grains, fruits, nuts, seeds, and garbage. This species commonly feeds in residential areas, campgrounds, pastures, croplands, orchards, and dumps. Starlings can form large wintering flocks capable of inflicting damage to crops (Zeiner et al. 1990b).

Nest boxes and buildings are secondarily essential habitat elements. Like house sparrows, starlings are aggressive competitors for cavity nest sites. They will use almost any cavity greater than 1.5 inches diameter in buildings, nest boxes or trees (Bent 1950). They successfully displace wrens, nuthatches, swallows, titmouse, bluebirds, kestrels, acorn woodpeckers and wood ducks (Kessel 1957; Small 1974; Troetschler 1976; Grabill 1977).

Studies of the use of mirrors, flashing lights, phenethyl alcohol, eyespots, magnetic fields, and avian-predator effigies as deterrents for starlings at artificial nest cavities show that each of these methods is ineffective (Belant et al. 1998; Seamans et al. 2001). The provision of nest boxes adjacent to active nest cavities did not help to alleviate nest-site competition between starlings and a native species (Ingold 1997). Researchers report, however, that the labor-intensive approach of continuously removing starling nests from nest boxes appears to be an effective method of controlling starling populations (Heusmann and Bellville 1978).

Human food scraps are an attractant for this species. The availability of food scraps can be controlled with proper garbage storage and public education about the effects of feeding wildlife.

VIRGINIA OPOSSUM

The Virginia opossum was introduced to California in 1910 from the American Southeast and is the only marsupial established in North America. Since 1910, the range of the opossum has expanded, and it is now common to abundant in woodland and brush habitats throughout California (Zeiner et al. 1990c). This species is designated as a DFG harvest species. The ideal habitat type for the Virginia opossum is valley foothill riparian, of which 159 acres exist within the project area. Limited observations of Virginia opossum occurred during relicensing field studies. Most observations (tracks and road killed individuals) occurred within the portion of the Oroville Wildlife Area bordering the Feather River.

The Virginia opossum has no essential habitat elements, but invertebrates and carrion are secondarily essential habitat elements. Brush piles, buildings, and habitat edges are preferred. This species' diet consists mainly of carrion and insects, but it also consumes fruits, berries, grains, green vegetation, earthworms, and fungi. Owls and dogs are predators of this species, and motor vehicles are important sources of mortality (Zeiner et al. 1990c).

The effect of opossum populations on native wildlife species has not been determined. However, this species is an excellent climber and may pose a threat to native bird eggs (Clark 1994). The Virginia opossum is also known to share the burrow systems or nests of other small to medium-sized mammals (Zeiner et al. 1990c), which may cause stress or resource competition. This species is known to raid garbage cans, bird feeders, and pet food (Clark 1994). The availability of these items can be controlled with proper storage of garbage and public education about the effects of feeding wildlife.

BLACK RAT

Black rats (roof rats) were introduced from Europe in the early 1800s and are relatively common in urban areas in California's Central Valley (Zeiner et al. 1990c). An ideal habitat type for this species is urban, preferably attics, rafters, and enclosed spaces in buildings (Godin 1977). There are 659 acres of urban habitat within the project area. Other ideal habitat types are sparse to moderate areas consisting of seedling or sapling trees in blue oak woodland and blue oak-foothill pine. Sparse areas consisting of seedlings to small trees in valley foothill riparian are also ideal. These stages of each habitat type do not currently exist within the project area. No black rats were observed during the course of the relicensing studies. However, this nocturnal rodent is difficult to detect without trapping.

The black rat has no essential or secondarily essential habitat elements, but does prefer the presence of campgrounds and dumps. This species is omnivorous, feeding on fruits, grains, fish, invertebrates, small terrestrial vertebrates, and human garbage (Zeiner et al. 1990c)

The black rat's closest competitors are the introduced Norway rat and muskrat. Where the black rat and Norway rat occur together, the black rat is usually forced to occupy the upper parts of buildings (Godin 1977). Snakes, owls, hawks, skunks, foxes, dogs, and cats are its main predators (Zeiner et al. 1990c).

Landscaping in areas of human use, such as campgrounds and recreation areas, can be carefully designed to reduce susceptibility to rodent infestation. Dense vegetation such as ivy, Pampas grass, Himalayaberry, and large areas of ice plant make control of this species difficult (Dutson 1973). Plants should be deciduous shrubs or broadleaf evergreens. Plants that grow in a vase shape are preferable to those that grow in a mounded or downward pattern. An open understory is desirable to prevent the accumulation of refuse (Colvin et al. 1996). A variety of commercial pesticides are available to control black rat populations in localized areas. However, it generally proves difficult to eliminate black rats from a wildland environment using pesticides without mortality of native non-target species.

Black rats carry a variety of diseases that can affect humans, including bubonic plague, rabies, typhus, tularemia, and trichinosis (Zeiner et al. 1990c). Human food scraps are an attractant for this species. The availability of food scraps can be controlled with proper garbage storage and adequate numbers of garbage containers.

NORWAY RAT

Norway rats were introduced from Europe in the late 1700s and occur within the valley portions of the project area. Norway rats occur in urban, agricultural, and native plant communities, including wetlands and riparian habitats (Zeiner et al. 1990c). An ideal habitat type for this species is urban, of which 659 acres exist within the project area. In urban areas, this species is more common in commercial restaurants and grocery stores than in residential areas. Other ideal habitat types are sparse to moderate areas consisting of seedling or sapling trees in blue oak woodland and blue oak-foothill pine. These stages of each habitat type do not exist within the project area. Rice agriculture also provides ideal habitat and is present immediately adjacent to the project area in the vicinity of the Thermalito Afterbay. No Norway rats were observed during the course of the relicensing studies. However, this species has been historically observed in ricefield habitats near the project area.

Norway rats do not have any essential habitat elements, but water, buildings, and dumps are secondarily essential elements. Campgrounds are preferred. The Norway rat is omnivorous and has a diet consisting of grains, fruits, insects, birds, mammals, garbage, and meat scraps. The Norway rat also preys upon the eggs of native bird species. Highest densities of this species occur in dumps and grain croplands (Zeiner et al. 1990c; National Audubon Society 1997).

The Norway rat is very aggressive and successfully excludes or preys upon the black rat where they occur together. Hawks, owls, foxes, mustelids, and snakes prey upon Norway rats (Zeiner et al. 1990c; National Audubon Society 1997).

The incorporation of rodent-proofing into landscaping helps reduce the susceptibility of an area to Norway rat infestation. Plants should be deciduous shrubs or broadleaf evergreens, or plants that grow in a vase shape rather than in a mounded or downward pattern. Plants that produce large amounts of fruits and seeds should be avoided, as they provide a food source for this species. Dense contiguous understories should be avoided because they tend to accumulate refuse where litter is a problem. Vegetation and benches should be planted or placed away from walls and fences, and irrigation should be designed to prevent the pooling of water (Colvin et al. 1996).

Like black rats, this species carries a variety of diseases including salmonellosis, tularemia, leptospiral jaundice, Haverhill fever, and typhus fever (Godin 1977). The Norway rat is known to gnaw on communication and power cables. Typically, anticoagulants are used to reduce populations of this species (Marshall 1992; Colvin et al. 1996), but could affect non-target species. Researchers have found that a treatment of capsaicin is an effective repellant to reduce cable gnawing by this species (Shumake et al. 2000).

Human garbage and sewage are attractants for this species. The availability of human food can be controlled with proper garbage storage and adequate numbers of garbage containers. Human sewage can be controlled by supplying adequate numbers of restroom facilities.

HOUSE MOUSE

House mice were introduced from Europe to North America in the 1600s and are common in the project area near human habitation. This species is less common in native plant communities or undisturbed areas (Zeiner et al. 1990c; National Audubon Society 1997). Ideal habitat types for the house mouse are annual grassland and urban, of which 803 acres and 659 acres exist within the project area, respectively. Other ideal habitats are sparse to moderately open areas of seedling to sapling-size trees in blue oak woodland and blue oak–foothill pine. These stages of each habitat type do not currently exist within the project area.

The house mouse does not have any essential habitat elements, but water, buildings, and dumps are secondarily essential habitat elements. Slash, brush piles, and campgrounds are preferred habitat elements. This species' diet consists of grains, fruits, seeds, vegetables, fleshy roots, meat, arthropods, glue, paste, soap, and other household items (Zeiner et al. 1990c). The house mouse has a very low water requirement (Rowe 1981).

Most carnivorous furbearers, as well as hawks, owl, voles, snakes, and rats prey on house mice. Native harvest mice and microtus (voles) dominate this introduced species, and the introduced Norway and black rats are common competitors (Zeiner et al. 1990c).

Like other introduced rodents which have evolved in close association with humans, this species can carry and transmit diseases, such as salmonellosis, to humans (Rowe 1981; Zeiner et al. 1990c). This species also destroys large quantities of grains by eating it or contaminating it with urine and feces. House mice are capable of chewing and shredding furniture and wires, and have been known to start fires as a result of these activities (National Audubon Society 1997).

Historically, the most common forms of house mouse control have been rodenticide application and the use of snap-traps. The repeated use of anticoagulants, however, has resulted in a response of anticoagulant-resistance in the species. Exposure to sub-lethal doses of acute poison has resulted in subsequent bait refusal. Snap-trapping has proven to be ineffective against dense or widespread populations (Rowe 1981). Due to the inefficiency of these commonly used methods, alternative methods have been researched. The introduction of artificial perches for raptors around an irrigated cropland allowed for increased hunting pressure and consequently decreased house mouse population rate of increase and population density. However, there was no significant reduction of crop damage as a result (Kay et al. 1994). For situations where lethal control methods are not acceptable, researchers have discovered that the application of cinnamamide to food stores effectively and persistently repels house mice, with the level of repellency increasing with each increase in concentration (Gurney et al. 1996).

House mice are attracted to human food scraps, supplies, and garbage. The availability of such attractants can be controlled through proper garbage storage, adequate numbers of garbage receptacles, proper containment of personal supplies, and public education.

MUSKRAT

The muskrat was deliberately introduced into northeastern California in the 1930s as a valuable resource for the fur trade, and is consequently designated as a DFG harvest species. Declining fur prices and trapping restrictions have greatly reduced the number of muskrat trappers (Shuler 2000). Ideal habitats for the muskrat are all habitat stages of fresh emergent wetland (of which 189 acres exist within the project area), montane riparian (of which 529 acres exist within the project area), and valley foothill riparian (of which 120 acres exist within the project area). Continually submerged muddy or organic substrates in lacustrine and riverine areas are also ideal habitats for this species. Muskrats were observed fairly frequently in lower elevation aquatic habitats including the Feather River, dredger ponds and flood detention areas in the Oroville

Wildlife Area, Thermalito Forebay, and Thermalito Afterbay. No muskrats were observed within Lake Oroville during the current relicensing studies.

Emergent aquatic vegetation, an herbaceous layer, and water are essential habitat elements for the muskrat. Graminoids, forbs, roots, and submerged aquatic vegetation are secondarily essential habitat elements. The muskrat's diet consists of aquatic plants, favoring roots and stems, as well as invertebrates and fish. Muskrats compete with the introduced Norway rat where the two coexist. Sympatric mink and muskrat population trends tend to be linked. Important predators of the muskrat are minks, raccoons, and other large bird and mammal predators (Zeiner et al. 1990c).

This muskrat is known to occupy human-made habitats such as roadside and irrigation ditches. Burrowing activities can result in extensive damage to dikes, levees, ponds, and ditches (Zeiner et al. 1990c; Shuler 2000). Damaged levees can lead to damaging flooding of adjacent lands. Burrowing within stream banks can cause a loss of overhanging cover, lead to bank collapse, and consequently change the stream width and amount of sedimentation. These factors can negatively affect the fishery of the stream. Muskrats can also cause damage to commercial crops such as corn, soybean, wheat, and oats. Muskrat burrows in pastures can lead to injury of cattle when the animals step into the burrow opening or fall into an area of collapse, and may allow cattle into a streambed when the burrowing activity causes the collapse of a fence (Shuler 2000).

Integrated pest management is the approach recommended by researchers. A combination of efforts is believed to be necessary to reduce the impacts of muskrats. Where possible, water levels should be drawn down in winter to expose muskrat dens and entrances to predators. Water levels should be raised during the denning season to flood burrows and disrupt the breeding season. Muskrats can be excluded from banks with a combination of concrete, netting, or rip rapping where appropriate. Conventional trapping and euthanasia of the animals year-round is another management option (Shuler 2000).

RED FOX

Two subspecies of red fox occur in California. Native red foxes are restricted to higher elevations with most sightings ranging from 3,900 feet to 11,900 feet elevation. The introduced subspecies generally occurs at elevations less than 3,000 feet (Schempf and White 1977). Original introduction of the non-native subspecies was related to hound hunting or fur farming in the 1870s. Red foxes within the project area are the non-native subspecies and use open habitats such as annual grassland, perennial grassland, emergent wetland, and cropland habitats. No ideal habitat type exists within the project boundary. No red fox have been observed or reported within the project area during the course of the relicensing studies.

The non-native red fox has no essential habitat elements, but stumps are secondarily essential. The presence of fences is preferred. This subspecies feeds primarily on small and medium-sized mammals, fruits, berries, and grasses (National Audubon Society 1997). But the red fox is believed to be an increasingly important predator of nesting waterfowl, shorebirds, and upland game birds as its range and density continue to expand within California's Central Valley. The non-native red fox appears to coexist with native canids including coyote, gray fox, and kit fox (Zeiner et al. 1990c). The coyote is known to be a direct competitor and predator of red foxes (Lewis et al. 1999). Numbers of red foxes apparently increase when numbers of other canids decrease (Zeiner et al. 1990c).

Non-native red foxes can carry and potentially transmit diseases such as rabies, distemper, sarcoptic mange, and parvovirus to pets. This species can also transmit rabies and bubonic plague to humans (DFG1994; Lewis et al. 1999).

Predator removal (trapping followed by euthanasia) is the main control method for red foxes. Studies show that this method can be effective at reducing population size, and consequently can reduce predation pressure on sensitive species. However, prolonged trapping tends to require an increased amount of effort for the same number of captures. Adult animals tend to represent the majority of animals captured, but it is possible that the removal of juveniles would reduce population size faster than the removal of adults (Harding et al. 2001). Another proposed alternative was the neutering of large numbers of red foxes, which might reduce population size in the long-term, but would not end the immediate threat of predation on sensitive species (Jurek 1992; Lewis et al. 1999). The reintroduction of coyotes as a biological control has also been considered, but areas where they were previously extirpated would have to be restored, and public safety would have to be considered (Jurek 1992).

In a study of the introduced red fox in southern California, researchers found that up to 50% of the species diet consisted of materials associated with humans, such as garbage and food purposely left out for them to eat (Golightly, Jr., et al. 1994). The availability of garbage and human food can be controlled with proper garbage storage and public education about the effects of feeding wildlife.

FERAL PIG

Feral pigs are a hybrid of domestic swine, which were allowed to forage freely as far back as the 1700s, and the European wild boar, which was introduced into California in the 1920s by a Monterey County landowner. This species is designated as a DFG harvest species. Feral pigs have become year-round residents in at least 56 of the state's 58 counties (Waithman 2001). Ideal habitat types for this species are areas of pole to large-size trees with moderate cover in blue oak woodland (of which 864 acres exist within the project area), blue oak-foothill pine (of which 3,034 acres exist within the project area), valley foothill riparian (0 acres of these stages of this habitat type exist within the project area), and montane hardwood (of which 1,727 acres exist within the project area). Areas of mature to decadent shrubs with moderate to dense cover in mixed chaparral are also ideal habitat types (of which 531 acres exist within the project area). No feral pigs were observed within the project area during the course of the relicensing studies. Further, no historical records of feral pigs within the project area have been identified.

The feral pig has no essential habitat elements, but acorns and a tree or shrub layer are secondarily essential habitat element. This species is omnivorous, with acorns serving as an important food source. Feral pigs also consume wild oats, grasses, forbs, berries, roots, bulbs, insects, crayfish, frogs, snakes, salamanders, mice, ground-nesting bird eggs, and carrion (Zeiner et al. 1990c; National Audubon Society 1997). Other than man, the adult of this species experiences light predation pressure. Baby boars are sometimes killed by bears, bobcats, mountain lions, or feral dogs (National Audubon Society 1997).

The rooting activity of the feral pig may cause damage to crop and pasture land, as well as to native vegetation. The disturbance of rooting activity can create opportunity for undesirable plant species to establish themselves (Hone and Stone 1989). Direct competition for acorns during low mast years may occur with mule deer, squirrels, black bears, acorn woodpeckers, and other native species. Destruction of nests of ground-nesting birds may also be a serious problem (Zeiner et al. 1990c).

Hunting pressure, despite a year-round season and lack of bag limit, is not strong enough to reduce feral pig populations in California. Typically, feral pig control is attempted through the use of bait piles soaked in a solution of the anticoagulant warfarin. Warfarin has an antidote in the event that a non-target species consumes the bait, and the levels of the poison tend to be sub-lethal in the carcasses that remain (Choquenot et al. 1990). Hunting and trapping are also common methods of feral pig control. Researchers warn, however, that economic incentives for hunting may cause private landowners to sustain the feral pig population, rather than reduce it. Similarly, if the cost of trapping is more than the economic damage caused by the feral pigs, the incentive to reduce the population is absent. A conflict of interest exists in controlling a non-native pest species that is also a lucrative game species (Zivin et al. 2000).

6.0 ANALYSES

6.1 EXISTING CONDITIONS/ENVIRONMENTAL SETTING

This evaluation has identified localized situations where the populations of two non-native species may adversely impact specific agency wildlife management goals.

Bullfrogs are present in high densities within the dredger ponds of the Oroville Wildlife Area. These population levels may be a factor in the low occurrence or absence of native ranids. However, high densities of a DFG harvest species within a DFG wildlife management area are not inappropriate. None of the potential control mechanisms identified within the literature review are appropriate for use within the dredger ponds. Concern over bullfrog impacts to native species occurs not only in California but throughout the western United States. Extensive control experimentation in California and elsewhere has not yielded viable control methods at this time.

DPR considers the relatively high population of wild turkey in the Loafer Creek area as inappropriate in a State Park setting. Several potential control mechanisms may be appropriate for DPR's use including trapping/relocation and increased sport harvest. Neither option will eliminate wild turkeys from the Loafer Creek area. However, DPR may employ these techniques to reduce the locally high densities. Wild turkeys in the Loafer Creek area have become habituated to human contact. Either of the potential control mechanisms could increase turkey wariness of humans and decrease their visibility within the State Park setting.

6.2 PROJECT RELATED EFFECTS

None of the other twelve non-native species considered in this assessment appear to currently occur in the project area at densities sufficient to adversely impact native species in any substantial manner. However, the control methods identified in this assessment may be appropriate for use in specific locations to meet agency management goals. Many of the control methods presented in this assessment have the potential to impact native species as well as the targeted non-native species. A thorough evaluation of impacts to native species from localized control activities should take place prior to implementation of non-native control.

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APPENDICES